

The self as a complex dynamic system

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Abstract

This article explores the potential offered by complexity theories for understanding language learners' sense of self and attempts to show how the self might usefully be conceived of as a complex dynamic system. Rather than presenting empirical findings, the article discusses existent research on the self and aims at outlining a conceptual perspective that may inform future studies into the self and possibly other individual learner differences. The article concludes by critically considering the merits of a complexity perspective but also reflecting on the challenges it poses for research.

Keywords: complexity theory, dynamic systems, learner differences, the self

"I think, therefore I am" has long been recognised as representing a very restricted view of the self. Consider the briefest selection of other verbs and their potential implications for understandings of the self: I feel (bodily and emotionally), I see, I hear, I sense, I experience, I relate to, I want, I hope, I fear, I remember, I change – therefore I am. The self is multifaceted and complex. It is the system at the centre of our lives helping us to make sense of our positions in the world and guiding our behaviour as we navigate our daily lives and interpersonal encounters. It is interconnected with the contexts in which we live and the people we meet and interact with. It provides us with coherence in our lives helping us to connect and interpret our past experiences and set future goals. It is not static but is continually developing as we progress through life. It lies at the very centre of our psychology bringing together who

we believe we are, what we feel, think, want and our strategies for action. Its importance in learning processes is central.

In this article, I would like to consider how best to accommodate some of the complexity surrounding the self into conceptualisations of language learners' sense of self. To do this, I would like to explore the potential offered by complexity perspectives and show how the self might usefully be conceived of as a complex dynamic system. The article will illustrate how a complexity perspective can unite and integrate a range of theoretical approaches to the self and thereby provide some theoretical coherence in the fragmented field of self, research (cf. Vallacher & Nowak, 1997). Rather than presenting empirical findings, the article discusses existent research on the self and aims at contributing towards the ongoing conversation about understandings of learners' sense of self (cf. Larsen-Freeman & Cameron, 2008, p. 255). The article concludes by critically considering the merits of a complexity perspective but also reflecting on its potential limitations and the challenges it poses for research.

The Importance of a Learner's Sense of Self

A learner's sense of self is central in guiding their behaviours and approaches to learning as it connects together many other aspects of their psychology such as their beliefs, motivation, affective responses, self-regulatory competence and strategy use. Although self-related constructs are widely recognised in psychology as playing a central role in learners' success in any academic undertaking (Pajares & Schunk, 2005), it is possible that a learner's sense of self may play an even greater role in language learning compared to other subjects. Language learning has a strongly 'social nature' given that, "language, after all, belongs to a person's whole social being; it is a part of one's identity, and is used to convey this identity to other people" (Williams & Burden, 1997, p. 115). As such, the self is implicated more than perhaps in the learning of other subjects, especially given the heightened role of self-presentation in FL use as well as issues of social and cultural identity (Mercer, 2011, p. 3). Indeed, Cohen and Norst (1989, p. 61) claim that their research shows that, "there is something fundamentally different about learning a language, compared to learning another skill or gaining other knowledge, namely, that language and self are so closely bound, if not identical, that an attack on one is an attack on the other".

In SLA, attention has focused more recently on self constructs, in particular self-concept, as a result of the 'L2 motivational self system' model of motivation (Dörnyei, 2005; Dörnyei & Ushioda, 2009) which has emerged to accommodate the multiple possible drives of learners who participate in increasingly

interconnected, multilingual and multicultural communities from across the globe. The model is based on self-discrepancy theories (e.g., Higgins, 1987) in which an individual compares their current self-concept with other possible self guides, such as their 'ideal self' and 'ought self', and is then motivated to reduce any perceived gap between their current self-concept and these 'ideal' and/or 'ought' self-concepts. In addition to self-concept (e.g., Henry, 2009; Mercer, 2011), SLA has also seen growing interest in various other self constructs such as self-efficacy (e.g., Graham, 2007; Mills, Pajares, & Herron, 2007; Hsieh & Schallert, 2008), L2 linguistic self-confidence (e.g., Clément, Noels, & Deneault, 2001; Rubinfeld, Clément, Lussier, Lebrun, & Auger, 2006), identity (e.g., Block, 2007; Morita, 2004; Norton, 2000), and learner self-representations (Pellegrino, 2005).

However, this plethora of self constructs reveals one of the problems facing any work in respect to the self in both psychology and SLA, namely differences in definitions, conceptualisations and ways of measuring or delineating self-related terms (cf. Brinthaupt & Lipka, 1992; MacIntyre, MacKinnon, & Clément, 2009). Whilst it is important for analytical purposes to know which unit of analysis is being employed, in reality the boundaries between the various self constructs are rather blurry and the sense or indeed phenomenological validity of trying to separate self terms is perhaps debatable (Mercer, forthcoming). It seems that the complexity of the self per se is mirrored in the complex interrelated web of definitions and terms used in relation to the self (cf. Vallacher & Nowak, 1997, p. 74).

Understandings of the Language Learner: One Turn after the Next

As with every discipline, SLA, and in particular the field of learner individual differences (IDs), has undergone a series of 'turns' in terms of the theoretical approaches and understandings of learners; each theory building on and extending the one before in a continual process of growth. These developments are more than merely fads or fashions; they serve as indications of the field's dynamism and progression. To be able to contextualise the conceptualisation of the learner ID 'self' proposed in this paper, it is necessary to appreciate how the perspective taken relates to the dominant theoretical paradigms in this field and their development.

One of the first major 'turns' was the 'affective turn'. With its roots in humanism, the affective turn drew attention to the neglected variable of affect and its role in learning processes. Rather than replacing or being viewed in opposition to cognition, an integrated approach has been advocated which recognises the role played by affect alongside cognition (e.g., Arnold & Brown, 1999). As LeDoux (1998, p. 39) argued, "minds have thoughts as well as emo-

tions and the study of either without the other will never be fully satisfying". Consequently, feelings and emotions are now acknowledged as being a crucial source of information and acting as a vital link between cognition, understanding, memory, motivation, and learning (Damasio, 1994; Immordino-Yang & Damasio, 2007; LeDoux, 1998; Reeve, 2005). However, there remains relatively little empirical work focusing explicitly on affect in SLA, albeit with notable exceptions such as Schumann (1997). Dewaele (2011, p. 23) has noted recently, however, that the "tide is changing" as the emotional dimensions of language learning become the focus of an increasing number of studies and special issues of journals.

The next major turn witnessed in SLA has been (or perhaps still is) the 'social turn' (Block, 2003). The major theoretical framework underpinning this development has been social constructivism. It has been invaluable in redressing the balance by accounting for contextual factors and considering the dialectic between learner and interactional contexts. In respect to learner IDs, it has shifted understandings away from abstracted constructs and has led to a consideration of how these interact with and are dependent on contextual factors. A particularly important dimension highlighted by socio-constructivist approaches has been the dynamism of variables across contexts and settings (Williams & Burden, 1997). Whilst the temporal dimension was not necessarily the focus of social constructivism, the recognition of the role of context and the potential dynamism of variables has led to an increase in process-oriented approaches and perhaps contributed to the 'dynamic turn'. As a result, many situated, longitudinal studies from social constructivist perspectives have emerged which have highlighted how various learner IDs can change both over contexts and time (e.g., Gao, 2010; Gu, 2009; Hosenfeld, 2003; Lamb, 2009; Morita, 2004). As such, many variables are no longer conceptualised as static constructs, but instead are understood as being situated and dynamic. A further consequence of these changes in conceptual understandings of learner IDs has been methodological developments, in particular increased openness to more qualitatively-oriented research approaches (e.g., Barcelos, 2003; Ushioda, 2009, 2011) which can perhaps better accommodate such situated, dynamic complexity (Mercer, 2011).

As a reaction against strongly cognitive models, socio-cultural theories have been important in highlighting the role of contextual factors and interactional contexts, but there has been a tendency for some proponents to unduly stress the role of context in a way that drastically reduces or indeed negates individual agency. A more balanced view is offered by realist perspectives which considers both structure (social relations and macro features of society) and agency (humans as agents in the human world) as interacting in a rela-

tionship of reciprocal causality (Sealey & Carter, 2004). Such a view conceives of humans as agents able to influence their contexts, rather than just react to them, in a relationship which emphasises the complex dynamic interaction between the two elements. Within psychology, the idea of interaction between both individuals as agents and social contexts has been supported most notably by Bandura (1989) who proposed his social cognitive theory. In this, he suggests a triadic model of human behaviour in which human functioning is seen as emerging from the complex reciprocal interplay between three constituent factors (1) intrapersonal (biological, cognitive, affective and motivational) thus involving the self, (2) behavioural and (3) environmental factors (Bandura, 2008). This theory is significant in balancing the role of the social and the cognitive without necessarily assigning primacy to either but also in recognising the role played by behaviour and actual experiences; indeed, it is the reciprocal interaction of all of these together that is important.

Focusing on the interplay between multiple variables is another recent development in respect to learner IDs. Increasingly, it is being recognised that many individual variables are intertwined and interrelated in reciprocal complex relationships. This suggests that such factors cannot meaningfully be separated from one another and, in fact, it may be the way in which factors combine that is significant for learning. For example, Cohen (2003) has examined the contextualised interactions between styles and strategies, explaining that understanding how they interact with each other in respect to a specific task is perhaps more meaningful and beneficial for research and pedagogy. More recently, he has added motivation to these two factors and shown the importance of examining the interaction between all three together, rather than each in isolation (Cohen, forthcoming). Dörnyei (2009) has also suggested examining combinations of factors and proposes taking a tripartite view looking for constellations of cognitive, affective and motivational factors that interact and function together as wholes. He concludes that "the traditional notion of individual difference factors, conceived as stable and monolithic learner characteristics, is outdated because it ignores the situated and multicomponential nature of these higher order attributes; the study of such complex constellations of factors requires a dynamic systems approach" (Dörnyei, 2009, p. 243).

Emerging from all of these developments and 'turns' in the field follows the "complexity turn" (Urry, 2005), which is currently influencing many disciplines including the social sciences and education. As a theoretical framework, complexity perspectives do not reject understandings from any of the previous theories outlined above, but rather attempt to incorporate all of the insights collectively. Complexity theory does not afford primacy to either structure or agency but sees an integrated role for both alongside other dimensions. Ma-

son (2008, p. 39) explains that complexity perspectives render “largely irrelevant the agency-structure debate about which of the two is more important in effecting change. Both are, and much else is too”.

When one cumulatively considers the insights emerging from the developments in theoretical understandings of learner IDs, and indeed in respect to other areas of SLA too, it seems almost to be a natural progression for the field to move, as has happened in other disciplines, towards a complexity perspective. Figure 1 below illustrates how these perspectives can be combined together and suggests the potential appropriacy of taking a complexity perspective.



Figure 1 The cumulative insights leading towards a complexity perspective

What are Complexity Theories?

It is impossible in a single article to provide sufficient background to address this question properly and fully. Under the umbrella of complexity theories are a whole host of different perspectives and frameworks. Indeed, after much reading on my part, I am left with the feeling that my own knowledge about the various multiple theories and related terminology remains partial. An interesting distinction is offered by Richardson and Cilliers (2001) who distinguish between approaches which adopt a ‘hard’, reductionist approach to complexity science, those which take a soft approach and those somewhere in between which they class as being engaged in ‘complexity thinking’. They acknowledge that these are not neat distinct categories but can help to identify the orientation of a study and the type of complexity perspective employed. As such, it may be helpful to think of complexity perspectives as representing positions on a continuum. The type of research approach taken on this scale will depend on the nature and characteristics of the area under investigation.

Basically, all complexity perspectives represent ways of understanding the world that tend to favour organic, complex, holistic models composed of complex dynamic systems, rather than cause-and-effect, linear models (cf. Morrison, 2008, p. 16). Essentially, a complex system is composed of at least two but usually a multitude of interrelated components which may themselves be complex systems. A defining characteristic is that of systems nested within other systems creating various multiple layers of complexity. In a complex system, environment or contexts are seen as integral parts of the system rather than as external variables affecting the system from outside. As such, 'context' itself must be understood as being a complex dynamic system composed of multiple components nested within other systems, rather than as a static monolithic notion (cf. Funder, 2001). As Dörnyei and Ushioda (2011, p. 32) explain, "Context is conceived not in static terms but as a developing process, while the relationship between individuals and a context is that of complex dynamic organic systems emerging and evolving over time". To help illustrate this idea of nested systems, a graphic is provided below adapted from Davis and Sumara (2006). It presents an example of some of the interrelated nested complex systems surrounding the learner and indicates how all of these systems are dynamic but potentially across different timescales.

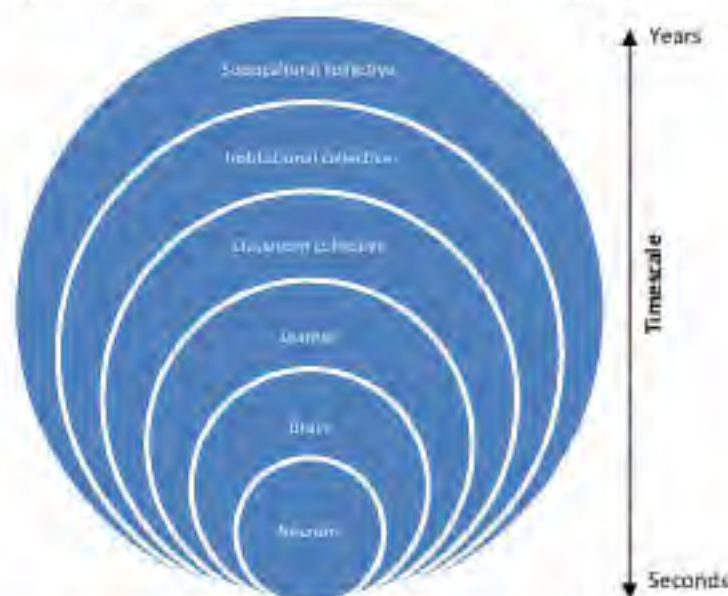


Figure 2 Nested systems around the learner based on conceptual models presented throughout Davis and Sumara (2006)

Complex systems inherently suggest the need for a holistic perspective which recognises that the emergent properties of the system as a whole are more than merely the sum of its separate parts (Mason, 2008, p. 33). Essential to this is the concept of emergence. This refers to changes in a system's state so that its emergent properties are different to those which existed before and also cannot be reduced to or explained simply by its individual components or the sum of the separate components. Emergence implies that the collective functioning of the interrelated parts of the system as one organic whole cannot be deduced from an understanding of the individual components. Although processes of emergence can be largely unpredictable, Haggis (2008, p. 158) reminds that there is also a degree of constraint on processes depending on the internal features of the system as well as its interactions with other larger systems, suggesting that what emerges is not entirely random either.

Emergence results from change and perhaps one of the most defining features of a complex system is its dynamic nature. Everything within the system is in a constant state of flux which can lead to changes in the system as a whole and to the ways in which the components of the system interact. Under this state of constant flux, a system can evolve and adapt to its environment thereby generating a form of 'dynamic stability' (Larsen-Freeman & Cameron, 2008, p. 43). This does not mean that a system is static but rather it can continuously adapt in order to retain a degree of stability. However, the system can also be dynamic in ways which lead to dramatic and possibly sudden change. As components are not independent of each other, changes in one part of the system will lead to changes in other parts of the system in ways that are not entirely predictable and hence complex systems are typically described as being non-linear. Such understandings reject simple cause-and-effect explanations of change and instead recognise the multiple, interrelated, potentially accumulative nature of interactions between various components which can lead to various degrees of change or dynamic stability. Causality becomes decentralised as there is no one single cause of change (cf. Haggis, 2008). As Dörnyei and Ushioda (2011, p. 37) explain, "because of the multiple interactions of the system constituents – which also involve environmental factors – the system is constantly in flux, but the direction of change cannot be ascribed to any single variable in isolation as it is a function of the overall state of the system".

In more mathematical-based models of complex dynamic systems, some of the characteristics outlined above referring to the dynamics of the system are expressed in terms of state space, system trajectories, attractors and attractor basins. Perhaps the most common term is 'attractors', which refer to a preferred state that a system tends to move towards or is 'attracted to'. In this paper, I have deliberately tried to avoid using many of these terms as at present I

have some concerns about the appropriacy of using such language in respect to learners, their characteristics and psychology. In the continuum of approaches suggested above (cf. Richardson & Cilliers, 2001), I would suggest that in viewing learners as complex dynamic systems, it may be more appropriate to take 'softer', more humanistic-oriented perspectives. Whilst such approaches are informed by ideas and principles generated by more mathematical models, understanding complex dynamic systems from such a perspective need not necessarily require the specific use of such terminology¹, which importantly can also hinder the accessibility of ideas for non-specialist readers.

The Learner's Self System

To try to make sense of the quagmire of definitions and constructs related to the self, I would like to suggest that conceptualising the self as a complex dynamic system can unite and provide coherence among the myriad of definitions and perspectives. To illustrate my rationale for conceptualising the self in this way, I will revisit some of my own empirical research and examine the existent literature to show how the self displays many of the characteristics typical of complex dynamic systems as outlined in the previous section.

Before I begin, a note about my use of self-related terms. In my own emergent understandings of the self as a dynamic system, I have used the term 'self' or 'self system' to capture its comprehensiveness and complexity. However, much of my own work and some of the specific ideas examined in what follows are based on the self-concept construct. As one of the most global and least context-bound of the self constructs, self-concept is ideally suited to more holistic views of the self (see Mercer, 2011, forthcoming). Essentially, a person's self-concept is everything they believe and feel about themselves. It can be conceptualised in global terms or in respect to specific domains and includes both cognitive and affective dimensions. In this conceptual paper, I will use the term self-concept when referring primarily to the psychological sense of self. Otherwise I will use the term 'self' to indicate the need to switch the unit of analysis to something bigger that can capture more of the holistic nature of the self system.

¹ For a more detailed exploration of such terminology and related concepts, the reader is advised to consult Larsen-Freeman & Cameron (2008).

Self Structure

Traditionally, self-concept has been conceptualised in terms of a hierarchy of multidimensional domain-specific self-concepts (Marsh & Shavelson, 1985); however, in my qualitative, grounded theory study based on data generated with tertiary-level EFL learners, the findings seemed to indicate something more complex (Mercer, 2011). Instead, I proposed that self-concept was best represented theoretically in terms of a contextualised three-dimensional network model (Mercer, 2011, p. 68). The model was used to describe the situated interrelatedness of one individual's self-concept network. The network structure and design of model was chosen for its potential to show the highly inter-connected nature of the innumerable self-concept domains, as well as the variation in terms of the relative complexity and salience of a domain for an individual, depending on how the person sees themselves and what values and beliefs are central to them at a particular time or in a particular context. The model was also able to display the potential for overlap and shared commonalities between domains as well as the nature of the different relationships between different domains in a particular context. Its three-dimensional structure aimed at conveying that a person's self-concepts could theoretically be interconnected *ad infinitum* with other domain-specific self-concepts in multiple, complex ways. Whilst the model out of necessity can only represent a snapshot of a fragment of an individual's self-concept network in a specific context at a particular time, the essence of the underlying form can be used to fundamentally understand the structure and nature of self-concept. Although it is virtually impossible to find anything to perfectly portray something so complex and dynamic, I felt it to be the most 'phenomenologically-real' representation of what emerged from my analysis of the data.

More recently my own interest in complexity theories has grown and I have since realised that there are considerable parallels between many of my findings, my network model and complex dynamic systems, although I was not aware of this theoretical framework at the time of my original research. A particular discovery which corresponds well with my descriptive model concerns network theory (Barabási, 2003, 2009) which has its origins in complexity perspectives. If self-concept is conceptualised as a network, as my data suggest, then network theory indicates that some domains may be more important than others for the health of the whole system. In respect to self-concept conceived of as a network of domains, this is indeed likely. Many researchers have suggested that domains of high personal value will have a greater impact on a person's entire sense of self than a domain of low personal interest or value to the individual (e.g., Hardy & Moriarty, 2006; Harter 1999; Pelham & Swann, 1989).

Once again, in a parallel to network theory, these 'core' domains may be of central importance to an individual simply given that they have played a bigger role for a longer period of time than others, or it may stem from the individual's emotional investment in the domain or indeed a combination of both. In network theory terms, such core domains in the self-concept network could be conceived of as hubs. A hub is centrally connected to multiple other parts of the network and plays a key role in the overall functioning of the network. If a hub suffers some kind of damage, the effect on the whole network is greater than if another node, or in this case domain, was affected. A network structure would also imply that the overall self system is tougher and more adaptable than a hierarchy, as networks are considered to be resilient structures, although they too have their weak spots and particular hubs (or domains) which are vulnerable. This would suggest that the self-concept network can be at once flexible and adaptive, yet simultaneously also coherent and dynamically stable, as suggested by the conflicting findings concerning the relative stability/malleability of the self (e.g., Markus & Kunda, 1986; Markus & Wurf, 1987). Networks can also grow over time and, similarly, an individual's self-concept network expands and changes every day as a person gains experiences, interacts with others and reflects on their lives (cf. Buchholz, 2008, p. 14). However, the resultant changes are not merely added on to the existent self-concept but they emerge from the interaction between the already existent self and these ongoing experiences and perceptions.

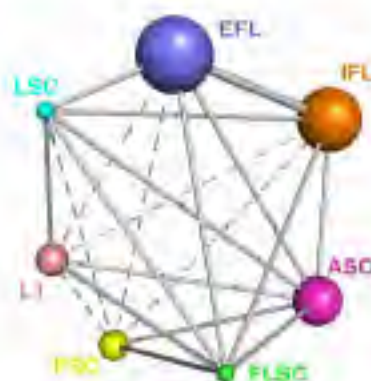


Figure 3 Network model of a case study student's self-concepts² (Mercer, 2011, p. 68). Reproduced with kind permission of Springer.

² The figure was prepared with the kind help of my colleague Karl Gruber using the programme PyMOL (www.pymol.org); Key: EFL = English as a Foreign Language Self-Concept, IFL = Italian as a Foreign Language Self-Concept, ASC = Academic Self-Concept, FLSC = Foreign Languages Self-Concept, PSC = Physical Self-Concept, LSC = General Languages Self-Concept, LI = Mother Tongue (German) Self-Concept.

Of particular interest to researchers is the understanding that network complexity does not automatically equate with randomness. Barabási (2003) makes the point that although there is complex variation in networks, they also have structure and follow certain laws of their topology and this could therefore potentially also be true for self-concept networks. Network theory suggests that there are patterns in structures and connections and overall network behaviours. Rather than assuming that all complex interconnected systems are randomly interlinked, many real networks have been shown to display non-random features and patterns which has led to the discovery of scale-free networks (Barabási, 2003). For research into self-concept, this conceptualisation would allow for uniqueness and individuality but also suggests the potential for discovering patterns and commonalities across learners' self networks in terms of how they develop, function and are structured.

I have been excited by the parallels I have found between my own findings and descriptions of network theory. Although I am at the outset of trying to better understand how this theoretical position may relate to self-concept, it does seem to offer a promising avenue of thinking to explore further in respect to how self beliefs and, indeed, possibly other belief systems are theoretically conceptualised (cf. Mercer, forthcoming). As Barabási (2003, p. 238) concludes, "Networks are the prerequisite for describing any complex system, indicating that complexity theory must invariably stand on the shoulders of network theory". As he further explains elsewhere, "Underlying connectivity has such a strong impact on a system's behaviour that no approach to complex systems can succeed unless it exploits the network typology" (Barabási, 2009, p. 413).

The Dynamic Self System

An important characteristic of self-concept is the finding that it can be both stable and dynamic. Originally self-concept was conceived of as a stable personality trait, but over time more researchers have come to understand it as a dynamic 'situational' construct (Pelham, 1991), as has also been the case in SLA in respect to many learner IDs. However, there remain differences in the relative degrees of dynamism/stability acknowledged and in how the stable and dynamic elements of self-concept are conceptualised (e.g., Harter, 1999; Markus & Kunda, 1986; Markus & Wurf, 1987; Mercer, 2009, forthcoming; Onorato & Turner, 2004). As Nowak, Vallacher and Zochowski (2005, p. 378) conclude, "The notion of personality implies some form of stability in thought, emotion and action. At the same time, human experience is inherently dynamic and constantly evolving in response to external circumstances and events".

These conflicting tendencies towards both stability and dynamism can more easily be reconciled when self-concept is conceptualised as a complex dynamic system (Mercer, forthcoming). Nowak et al. (2005, p. 354) propose that in a psychological system, the relative stability is similar to the notion of equilibrium or homeostasis. They explain that people are “motivated to bring about and maintain various psychological states, whether cognitive (e.g., a belief), affective (e.g., a judgement or attitude), or behavioural (e.g., an action tendency or desire) in nature” (Nowak et al., 2005, p. 354-355). In other words, although the psychological system may go through changes, people seek to maintain a sense of coherence and stability in their various psychological states. Nowak et al. (2005) conceptualise this proclivity for change and simultaneously a maintenance of internal stability in terms of attractor dynamics, in particular fixed-point attractors. In respect to the self, this idea of stability and maintaining one’s self views also forms the basis of Swann’s (1997) theory of self-verification, whereby an individual seeks evaluations that confirm their self-views that can provide them with a sense of coherence to their sense of self, which he argues is important for their overall psychological well-being.

Another aspect of self-concept dynamism that can be understood through a complexity lens concerns the internal/external frame of reference model (I/E model) about how individuals form their self-concepts (Marsh, 1986a). The model suggests that learners form their self-concepts through evaluations based on both internal and external frames of reference. In other words, learners use external frames of reference such as comparing themselves to others and feedback from grades and exams. However, they also use internal mechanisms such as comparing their self-beliefs across domains and using other belief systems and affective responses/states as frames of reference (Mercer, 2011). Essentially, the I/E model shows that self-concepts are not merely formed as a result of the unidirectional influence of external factors and contexts but the effects of these situated experiences are also mediated by other psychological internal processes (Mercer, 2011; Nowak et al., 2005).

In other words, the self is continually interacting with the environment in the form of experiences, social cues, interactions with significant others, reflected appraisals etc, but these do not appear to influence the self in a straightforward linear manner. Rather the existent self interacts with these experiences, compares, mediates, evaluates, reflects upon and then adjusts, adapts and develops in a manner which is not easily predictable. The processes of adjustment in which external experiences are mediated or driven by internal processes can also be seen in the work on self-related processes such as compartmentalisation (Showers, 1992), self-serving bias (Marsh, 1986b), self-verification (Swann, 1997) and self-enhancement (Brown, 1986).

Together these processes indicate that the self is not just reactive and subject to the unidimensional influence of external factors but is also an active agent in self construction. In self-concept formation, neither external nor internal processes necessarily have primacy over the other, but it is the complex interaction of both that leads to the emergent development of self. As such, the emergent self becomes a different entity than the sum of its parts and cannot be separated into separate beliefs and feelings independent of each other and its prior state. In this way, the self can be considered as displaying characteristics of emergent self-organisation, which is typical of a complex dynamic system (cf. Nowak et al., 2005).

Situated and Embodied Selves

In research on the self, there has traditionally been a division between those who take a more strongly 'internal' cognitive-individual view, and those who advocate a stronger contextual socio-cultural perspective (cf. Pintrich, 2003). Either view to extreme is not likely to be useful but rather as has been shown above, it is the interaction of internal mechanisms and external contexts, experiences and interactions which combine to create change and development in the self. I would suggest that now it is almost universally accepted that self-concept is a situated construct and that sociocultural contexts, environmental factors and interpersonal interactions influence the way the self is personally conceived and develops. However, opinions still diverge about directions of causality and degrees of individual agency in these interrelationships.

An approach which acknowledges the bidirectional interactions between self and contexts can be found in ecological perspectives on the self (Hormuth, 1990). In these, the self is seen as reflecting external elements of its environments, objects and interactions with others and is seen as part of the ecological system: "The self-concept develops and exists in interaction with its social and physical environment to form an ecological system for the self" (Hormuth, 1990, p. 5). Whilst such a perspective combines the self and external systems, it still assigns a degree of primacy to external environments as the self is viewed as only being able to change in reaction concurrently or subsequently to environmental experiences, contexts, objects and interactions (Hormuth, 1990, p. 197).

More recently Marsh, Johnston, Richardson, & Schmidt (2009) proposed a 'radically embodied, embedded perspective' termed 'a social synergistic approach', which has its roots in ecological perspectives but combines this with an explicit dynamic systems perspective. It employs the concept of affordances to argue how causality lies in the synergistic interaction and interrelations between both the self-concept and its multiple environments (cf. Marsh et al., 2009, p. 1219).

These differently situated perspectives all highlight the close connection between the self and contexts and this in turn has led to an interest in a particular concept of situatedness, namely that of embodiment. This refers to the idea that cognition is embedded “both in body and world” (e.g., Atkinson, 2010, p. 606). Atkinson refers to this as the ‘inseparability principle’ in which mind, body and world work together. Smith defines (2005, p. 279) the embodiment hypothesis as, “the idea that intelligence emerges in the interaction of an organism with an environment and as a result of sensor-motor activity”. She goes on to argue that this understanding of embodiment also emphasises the dynamic and emergent nature of knowledge linked to real-world and real-time processes and, as such, concludes that cognition is best understood as complex dynamic system. Indeed, others have also rejected the dualistic separation of mind and body. Combining insights from developmental psychology and neurosciences, Thelen and Smith (1994), for example, show that human development, admittedly in respect to motor behaviour, can be understood from a dynamic systems perspective which recognises the central role played by bodily experiences in both cognition and action.

In my own research, I have also found that respondents’ self-concepts can vary depending on physical bodily factors such as when the person was tired, unwell or was uncomfortably cold/hot etc (Mercer, 2009). In other words, the internal thoughts and feelings of the self are also connected through the body to the world, and the three – mind, body and world – cannot meaningfully be separated.

Together situated and embodied perspectives on the self suggest that understanding an individual’s sense of self requires an appreciation of the complex interrelationships between a learner and their multiple layers of contexts as well as their physical interconnections to their environments. Essentially, they highlight the importance of taking a truly holistic view of the self and warn of the partial and fragmented picture that emerges if one tries to separate the psychological self from its body and multiple contexts across time and place. I have found that one of the best ways to attempt to integrate all these different views of the self is to begin by understanding the self as a complex dynamic system.

Implications and Challenges of a Complexity Perspective

For Research

As Dörnyei (2009, p. 244) cautions, complexity approaches take us into uncharted territory in terms of theoretical and methodological issues; none of

which will be straightforward to address. Any major shift in thinking will bring with it transitional problems for the discipline; however, as Thelen and Smith (1994, p. 341) explain, once you begin to view the world from a complex dynamic systems perspective, the ideas are so powerful and omnipresent that it is hard to go back to any other way of thinking about the world, or in my case, about learners, learning environments and processes of learning. Complexity theory creates comprehensible coherence and unites many fragmented and often competing theoretical perspectives. Nevertheless, despite its intuitive appeal, care must be taken not to automatically assume that a construct is a complex dynamic system, simply because it does not appear to function in a straightforward and linear manner (cf. Swan, 2004). One of the challenges facing research is to generate data and find ways of researching to empirically support hypotheses and metaphorical propositions, which suggest the merits of viewing learner ID variables in terms of complex dynamic systems.

In order to meet the challenges posed by a complexity perspective, researchers will need to be innovative and creative in developing a range of research methodologies if we wish to capture the complexity and dynamics inherent in such systems. It is clearly a call for methodological diversity and presents a wonderful opportunity for collaborative research projects and dialogue across methodological borders (cf. Macintyre, Noels, & Moore, 2010). In relation to the self from a complex dynamic systems perspective, one original approach currently being used in combination with more traditional methods is the 'mouse paradigm' to track mouse movements across a computer screen which indicate the variability of a person's moment-to-moment self-evaluative thoughts and feelings as they unfold and are revealed through use of the cursor in relation to a target on screen indicating a positive self-evaluation (Buchholz, 2008; Vallacher, Nowak, & Froehlich, 2002). In respect to motivation, Ushioda (2007 cited in Dörnyei & Ushioda, 2011) suggests conducting a micro-level analysis of interactional data to examine motivation as it evolves and emerges through discourse using conversational analysis. Other methodologies suggested for complexity perspectives include, for example, the use of computer simulations (e.g., Nowak et al., 2005), computer modelling, using free modelling software such as netlogo, 'complexity thought modelling' describing the system based on qualitative approaches (Larsen-Freeman & Cameron, 2008), and qualitative longitudinal case studies (Mercer, forthcoming).

A particular challenge for research is the problem of how to select boundaries for do-able, practical research in terms of the focus of the study and units of analysis. The inherent scope and complexity of a complex dynamic system makes researching it in its entirety impossible as it is nested in related and interacting systems and thus some degree of reductionism is inevitable. In terms of focus,

Dörnyei and Ushioda (2011, p. 246-249) suggest that researchers can concentrate on four key areas: (1) attractors and attractor states; (2) contexts; (3) change rather than variables *per se*; (4) system modelling. In particular, they suggest that attractors are "the key to researching complex dynamic systems" (Dörnyei and Ushioda, 2011, p. 247) given that if a system is governed by strong attractors, it will become more predictable and thus researchable. Whilst there is a temptation to want to seek out patterns which reduce ambiguity, perhaps one of the appealing characteristics of a complex dynamic system is its potential to help us to appreciate and better understand the unpredictable, complex and unique nature of learners. Research approaches that can also capture this dimension will have a potentially central role to play and are particularly appealing.

Given the key characteristics of a complex dynamic system are change and the interrelations between components; it would also seem wise to focus attention on these two features. Firstly, attending to the dynamic nature of a system is central and suggests that longitudinal research may need to become a more common format. However, it must be remembered that, as shown above in Figure 2, timescales can vary and longitudinal need not be conceptualised in terms of months or even years. It is possible that, for example, minutes may represent an appropriate timescale for analysis if the dynamics of an interaction are being examined. Another important suggestion in this respect is that in order to capture different forms of variability and change, it can be useful for longitudinal case studies to also collect data at differing intervals to cover different timescales (Larsen-Freeman & Cameron, 2008, p. 245).

The second key characteristic of complex dynamic systems is the relationships between key components and how they interact and this may present another rich area for research to explore. Although once again, selecting particular relationships to focus on and setting feasible boundaries for such research means that out of necessity researchers will have to engage with a delineation and partial representation of a potentially bigger system. However, as Larsen-Freeman and Cameron (2008, p. 245) suggest there are various possible meaningful ways of setting such a focus. Referring to the biologist Lewontin (1998), they suggest considering the functional purpose of the system as whole and whilst the focus on certain relationships may partial in terms of the entire system, it can concentrate on a 'functional whole'.

In addressing the issue of units of analysis in researching complex dynamic systems in respect to learner IDs, Dörnyei (2009) has suggested taking a tripartite view and looking for combinations or constellations of cognition, affect and motivation that interact and function together as wholes. Although constructs cannot sensibly exist as separate from other components in a complex dynamic system, Dörnyei (2010) suggests that if they are sufficiently phe-

nomenologically distinct, there may be sense in continuing to research these whilst maintaining an explicit awareness of their position in relation to other components nested within a dynamic system.

Indeed, I would argue that promoting a complexity perspective need not imply an automatic rejection of single variable and correlational-style studies as these too “have the potential to uncover the missing pieces of the puzzle and enhance our understanding of the intricacies of individual variation in language learning and teaching” (Pawlak, 2009, p. 21). Not everybody needs to jump on board the complexity bandwagon. Other forms of research and perspectives can contribute valuable insights towards the big picture. In fact, meta-analytical overview papers can provide a useful service in examining existent studies from a range of perspectives and research traditions in order to consider them collectively and piece together their findings to form a more complete, holistic picture. When faced with dynamic complexity, no single method or research design will be able to adequately and comprehensively capture this but a combination of different approaches can together all contribute towards such an ideal (cf. Hormuth, 1990, p. 8).

In its simplest form complexity can become a way of thinking (cf. Morrison, 2008) and need not necessarily become a methodological paradigm. It requires an honesty and humility about the boundaries of our knowledge and potential scope of our claims. For all forms of research, but possibly especially in respect to learner IDs, there is a need for a greater awareness that what we see are fragments and only a partial description of the bigger picture that is the holistic individuals who are our learners. It suggests the importance of combining insights from across theoretical paradigms, discourses and research traditions (cf. MacIntyre et al., 2010). We need to appreciate that research reports and articles are not irrefutable statements of fact nor do they represent a finished end product, but rather can be fruitfully considered as ‘contributing to the shape of possibility’ (Davis & Sumara, 2006, p. 161) in the field’s continually emergent body of knowledge, understandings and theoretical paradigms in respect to learner IDs.

For Pedagogy

Although complexity perspectives have impressive descriptive powers and appear to more closely reflect realities than abstracted models (e.g., Dörnyei & Ushioda, 2011), researchers in applied linguistics also have a responsibility to consider the practical implications of their work. This should not mean that researchers have to search for pedagogical recipes but as a theoretical perspective, complexity theory must also meet the criterion test of ‘appli-

cability' – an ability to relate to real situations (McDonough, 2002, p. 24). As an applied discipline, theories are required that can inspire practical applications and have real-world pedagogical relevance. Morrison (2008, p. 28) rightly asks what "added value" does complexity theory bring? He goes on to ask "how far education and practice *need* complexity theory?" Although other theoretical approaches have not always offered pragmatic advice either (Davis & Sumara, 2006), the 'value' of complexity perspectives will be a key question that we will need to truly engage with and reflect critically upon in the coming years. Although I am attracted to its ability to describe and capture more fully my understandings of the learner's sense of self (and potentially all aspects of their psychology), at present I remain concerned about the potential of complexity theory to translate into useful practical insights and thus truly benefit practising language teachers and our actual learners. However, as the theory is breaking new ground, perhaps we simply need more time in order to better appreciate and understand the potential contribution it can make to practice.

As has been my own personal case so far, possibly the key contribution of complexity theories lies in their potential as alternative ways of thinking. They can prompt us to question and critically examine our assumptions about aspects of learning and teaching that we may take for granted and unwittingly conceptualise in terms of unidirectional linear patterns. Understanding the concept of decentralized effect and the idea that there is not a single cause controlling the system means that teachers can appreciate that it is not just or even necessarily primarily the teacher who 'controls' processes of learning but rather teachers can perhaps create the momentum needed to trigger change, development and learning (cf. Davis & Sumara, 2006). For educators this can be liberating as it makes it clear that there cannot be any easy magic pedagogical recipes for success and it sensitises us to the wide range of possible factors that need to be attended to when working with complex, dynamic, holistic individual learners.

Inspired by an idea from Dörnyei and Ushioda (2011, p. 104), it may be best to think of the insights emerging from complexity-based studies in terms of their ability and usefulness in raising teachers' 'complexity awareness' and in developing complexity-sensitive understandings of schools, classrooms, learner groups, individual learners and learning processes (see also Larsen-Freeman & Cameron, 2008). Whilst some teachers may already possess such an awareness, others may benefit from more explicit consciousness-raising about the complexity involved in language teaching and learning and the individuals (both teachers and learners) who undertake such a venture.

Conclusion

In this paper, I hope to have shown how complexity thinking can provide a coherent framework which unites competing perspectives and helps us to understand potentially conflicting findings concerning the self. Firstly, consistent with a complexity perspective, the self can be understood as a multidimensional network of situated and embodied interrelated self-beliefs and affective states. Its simultaneous stability and malleability can also be explained when conceived of as a complex dynamic system, as can its dynamic development in which both internal and external processes constantly interact giving rise to emergent changes (or dynamic stability) as the self system continually self-organises. Building on earlier insights, a complexity perspective on the self represents a more evolved and exciting set of understandings; "Gone are the simplistic views of linear causality, the ability to predict, control and manipulate, and in come uncertainty, networks, connection, interdependence, self-organization, emergence over time through feedback and the relationships of the internal and external environments, and survival and development through adaption and change" (Morrison, 2005, p. 318-319).

Many challenges lie ahead but there are potentially rich insights to be gained from this perspective not only for those interested in the self in its various current guises but also for other areas of learner psychology, work in learner individual differences and indeed any inquiry seeking to understand our learners as holistic, unique individuals. What we now require is patience to come to terms with the methodological and practical implications of this perspective so we can ensure that the current 'complexity turn' makes a truly valuable contribution to the emergent complex dynamic system of knowledge in this field.

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